Aug. 6, 1946. H. J. DE N. McCOLLUM 2,405,317

HEATER

Filed April 29, 1943 3 Sheets-Sheet 1

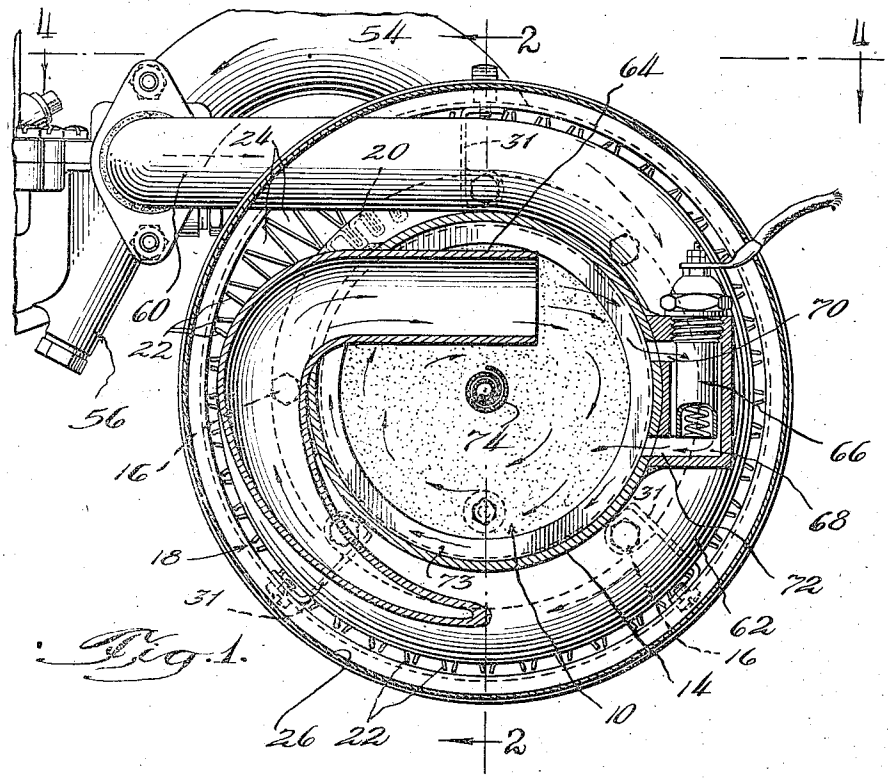


Fig. 1.

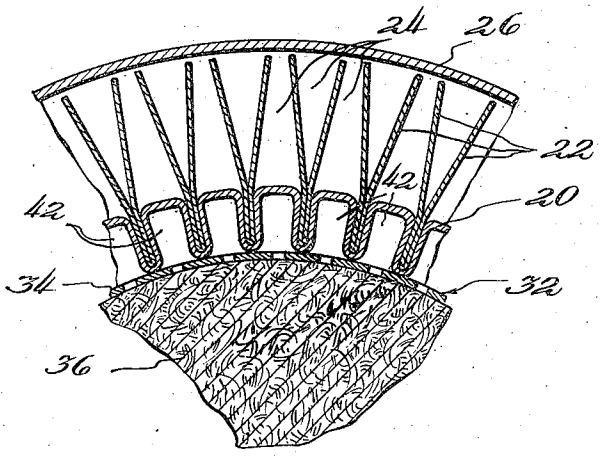


Fig. 3.

Inventor.
Henry J. De N. McCollum
By Williams, Bradbury & Hinkle
Attorneys.

Aug. 6, 1946. H. J. DE N. McCOLLUM 2,405,317

HEATER

Filed April 29, 1943 3 Sheets-Sheet 2

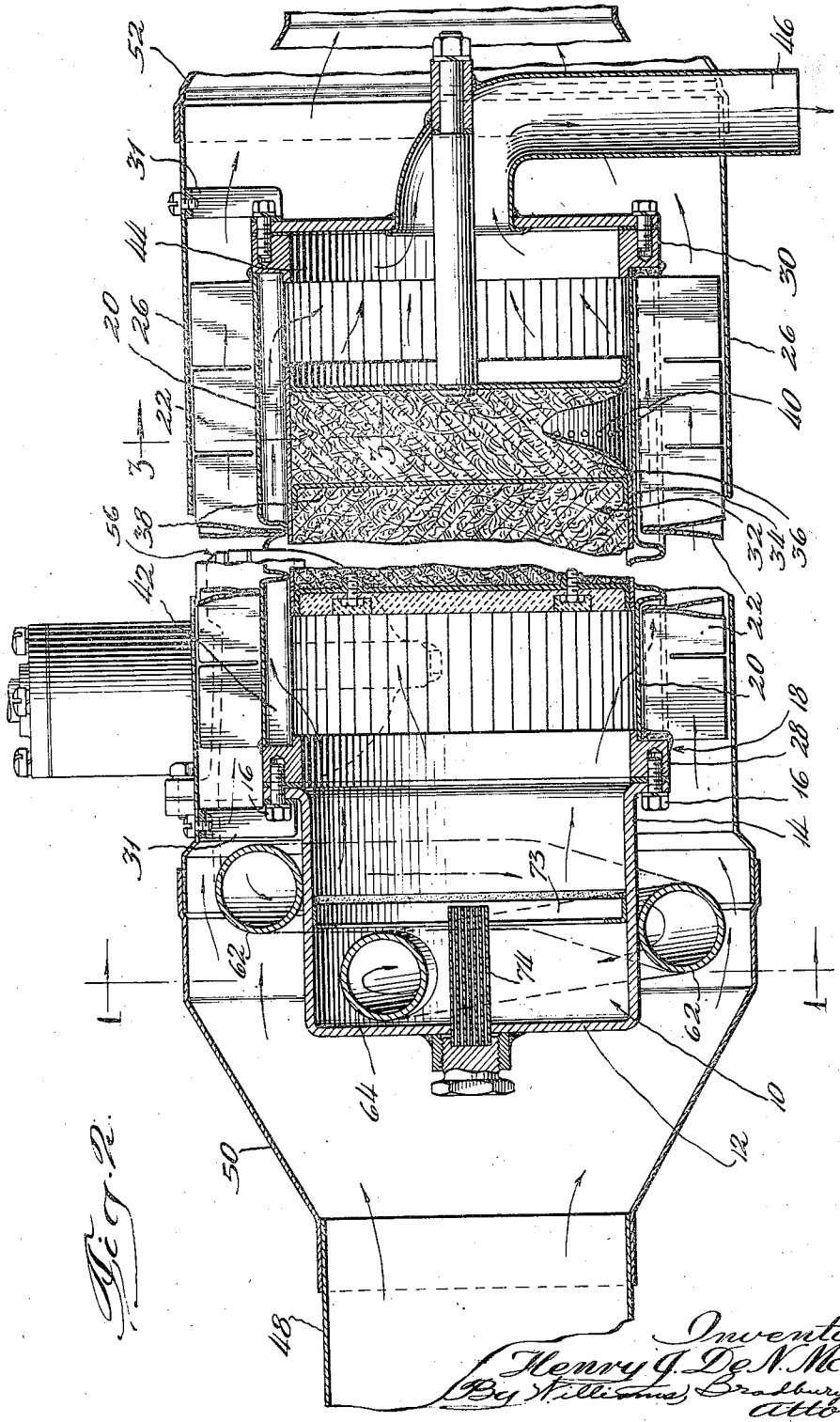


Fig. 2.

Inventor:
Henry J. De N. McCollum
By Williams, Bradbury & Hinkle
Attorneys

Aug. 6, 1946. H. J. DE N. McCOLLUM 2,405,317

HEATER

Filed April 29, 1943 3 Sheets-Sheet 3

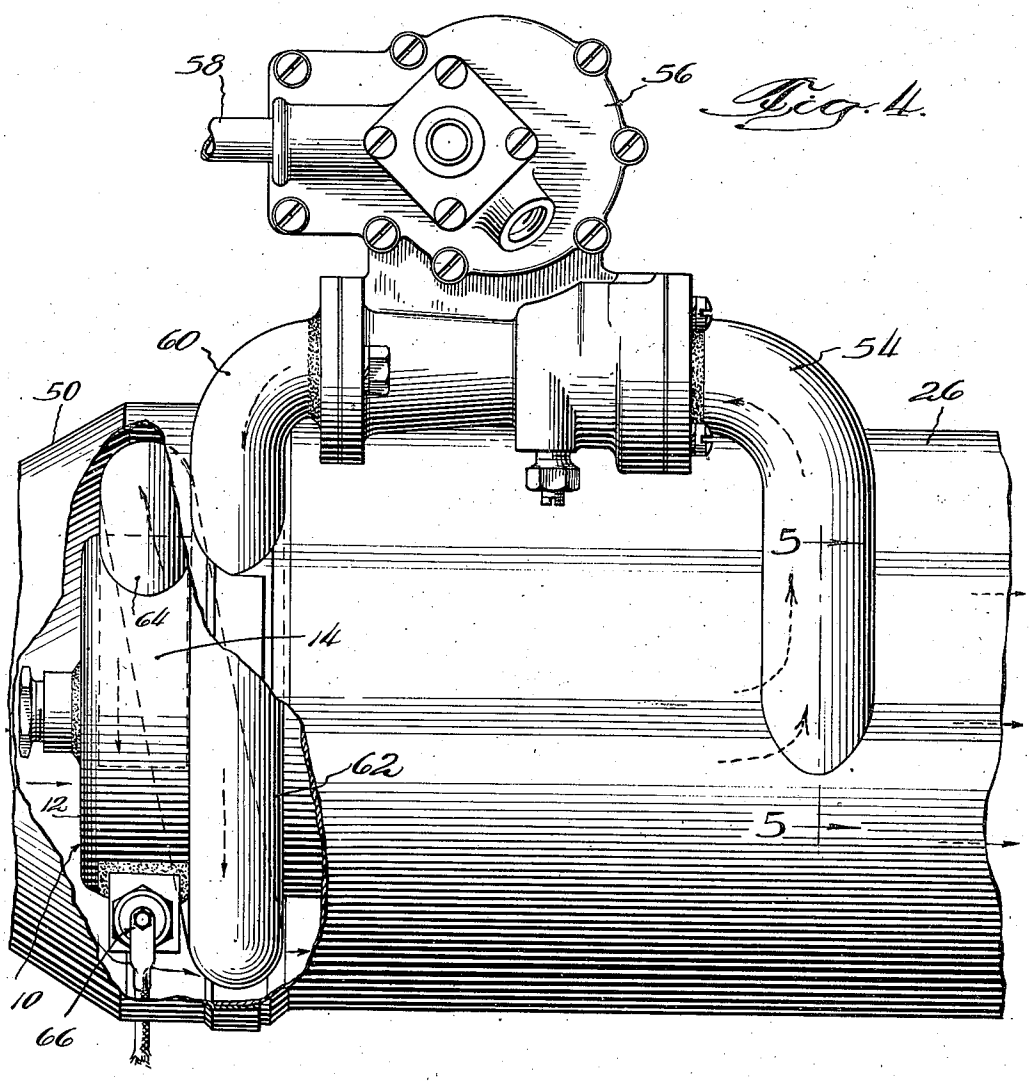


Fig. 4.

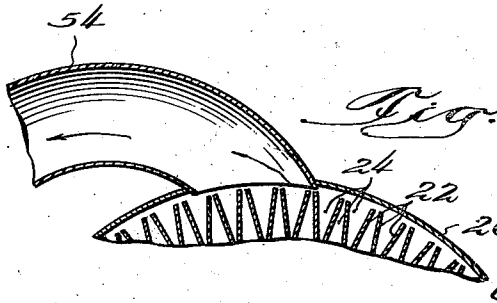


Fig. 5.

Inventor:
Henry J. De N. McCollum
By Williams, Bradbury & Hubbell
Attorneys

Patented Aug. 6, 1946

2,405,317

UNITED STATES PATENT OFFICE

2,405,317

HEATER

Henry J. De N. McCollum, Chicago, Ill.; Thelma McCollum, executrix of said Henry J. De N. McCollum, deceased

Application April 29, 1943, Serial No. 484,971

3 Claims. (Cl. 158—28)

1

My invention relates to heaters and is more particularly concerned with heaters of the internal combustion type commonly used to heat airplanes and for other similar purposes.

In airplane heaters it is usual to supply the ventilating air and combustion air by means of rams or blowers and it is particularly desirable to utilize a heater which offers minimum resistance to flow of combustion air and ventilating air therethrough.

An object of my invention is to provide a heater which affords reduced resistance to air flow therethrough.

Another object of my invention is to provide a heater having a circular combustion chamber and an induction pipe for supplying a combustible mixture to such chamber at the lowest rate of flow which will prevent the occurrence of combustion in said induction pipe.

Another object of my invention is to provide a heater having an induction pipe offering minimum resistance to flow therethrough.

Another object of my invention is to provide a new and improved heater which prevents the formation of ice in the carburetor supplying combustible mixture to the heater.

Another object of my invention is to provide a heater having a new and improved means for preheating combustible mixture delivered thereto.

Other objects and advantages will become apparent as the description proceeds.

The invention disclosed and claimed herein is an improvement on that disclosed and claimed in my co-pending application, Serial No. 477,030, filed February 25, 1943.

In the drawings:

Fig. 1 is a transverse, sectional view through a heater embodying my invention and is taken on the line 1—1 of Fig. 2;

Fig. 2 is a longitudinal, sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a partial, sectional view showing details of construction of the heat exchanger and is taken on the line 3—3 of Fig. 2;

Fig. 4 is a partial top plan view with part of the casing cut away to show more clearly parts of the induction tube; and

Fig. 5 is a partial, sectional view taken on the line 5—5 of Fig. 4.

Referring particularly to Fig. 2, it will be seen that I have provided a heater having a combustion chamber 10 provided with an end wall 12 and a cylindrical side wall 14. The combustion chamber 10 has an open end attached by bolts 16 to one end of a generally cylindrical heat exchanger 18. This heat exchanger comprises a corrugated sheet metal shell 20 (Fig. 3) to which are attached by welding, soldering, or otherwise, a plurality of longitudinally extending fins 22 which project into the ventilating air passage 24 formed between the shell 20 and an enclosing cylindrical casing 26.

2

The ends of the shell 20 are soldered, welded, or otherwise secured to rings 28 and 30 which form the ends of the heat exchanger and these rings may be secured to the casing 26 by supporting straps 31, or in any other suitable manner.

A muffler 32 is located in the cylindrical heat exchanger 18 and comprises a sheet metal shell 34 containing sound absorbing material 36, such as stainless steel wool or glass wool. The shell 34 is divided into a plurality of compartments by partitions 38 and in the particular muffler shown each compartment is provided with a single annular series of openings 40 providing acoustic couplings between the interior of a compartment and the gas passages 42 formed between the muffler shell 34 and the heat exchanger shell 20.

Hot gases of combustion issuing from the open end of the combustion chamber 10 are directed into the lefthand ends of the passages 42 by the muffler 32 and flow lengthwise of these passages to give up their heat to the heat exchanger 18. The cooled gases of combustion flow from the righthand end of the passages 42 into an outlet chamber 44 and are discharged to atmosphere through an exhaust fitting 46 and any suitable exhaust pipe attached thereto. Air is supplied to the heater from any suitable ram, blower, or other source of supply through a pipe 48 connected to a tapered inlet 50 attached to the lefthand end of the casing 26. Air entering the heater first passes around the combustion chamber 10 and absorbs some heat from the walls thereof. This air then flows through the ventilating air space 24 and absorbs additional heat from the fins 22 and exposed wall of the shell 20. Most of this ventilating air then passes from the righthand end of the casing 26 into a tapered outlet 52 leading directly into the airplane cabin or other space to be heated or into a duct system having a plurality of outlets at selected locations in the same or different spaces.

A small part of the air flowing in the ventilating air space 24 enters a carburetor air pipe 54 whose inlet end is preferably located about midway of the heat exchanger 18 so that air entering this pipe has been preheated to an appreciable extent. The inlet end of the pipe 54 is preferably

located adjacent the top of the heat exchanger and this pipe is illustrated in Fig. 1 as having its central portion arched upwardly above both its inlet end and its outlet end, which is attached to a carburetor **56**.

While this arrangement is particularly desirable, it is not essential, although the carburetor **56** should preferably be located below the inlet end of the carburetor air pipe **54** so that any leakage at the carburetor jet which might occur when the heater is not in use, can not flow through the carburetor air inlet pipe **54** into the ventilating air passage **24** in the heater and mix with ventilating air subsequently supplied by the heater to the passenger space of the airplane.

The carburetor **56** is connected by a pipe **58** with any suitable source of fuel supply and furnishes a mixture of fuel and air to the induction pipe **60**, which conducts this mixture to the combustion chamber **10**. The carburetor **56** is located outside of the casing **26** so that both the combustion air pipe **54** and the induction pipe **60** pass through this casing. A portion **62** of the induction pipe **60** is wrapped around the cylindrical wall **14** of the combustion chamber **10** in the form of a helix, as best shown in Figs. 1 and 2, so that heat is transmitted from the wall of the combustion chamber to this portion **62** of the induction pipe and serves to preheat the fuel and air mixture passing through this pipe. The combustion chamber and induction pipe are preferably, but not necessarily, made of stainless steel and if it is desired to augment this heat transfer, the wrapped portion **62** of the induction pipe may be welded or soldered to the cylindrical wall **14** of the combustion chamber.

The induction tube **60** terminates in a straight outlet end **64** which extends into the combustion chamber and transversely thereof. This end is parallel to a tangent to the wall of the combustion chamber and delivers the mixture of fuel and air to the combustion chamber in a direction approximately tangential to the circular wall thereof so that this mixture whirls about the axis of the combustion chamber to create a ring of flame therein. This combustible mixture is ignited by an electrical igniter **66** located in a pocket **68** outside of the combustion chamber and connected thereto by inlet **70** and outlet **72** passing through the wall of the combustion chamber.

The outlet end of the induction tube is so positioned that it directs part of the combustible mixture discharged therefrom directly through the inlet **70** and into pocket **68** where it may readily be ignited by the igniter **66**. A ring **73** prevents liquid fuel and particularly rich mixtures of fuel and air from escaping from the combustion chamber before they can be burned completely. A re-igniter **74** is provided to maintain combustion after the electrical igniter **66** is disconnected from its source of current by the usual thermostatic switch.

In order to reduce to a minimum the resistance to the flow of air through the heater, the induction tube **60** is preferably made as large as possible. This tube, however, can not be made so large that the rate of flow of combustible mixture therethrough is too low in any portion of the tube to blow out of the tube any combustion which may take place therein. For example, whenever any temporary interruption of the air supply to the heater may reduce the rate of flow of combustible mixture through the induction tube **60** sufficiently to permit the fire to enter this

tube and, after the temporary interruption has passed and normal flow has been restored, the rate of flow of combustible mixture throughout the entire cross-section of the induction tube must be sufficient to blow the burning gases out of the discharge end thereof so that thereafter all combustion occurs in the combustion chamber.

Where the outlet end of the tube is curved as in my aforesaid prior application, the flow of combustible mixture in the induction tube and along the inner wall of the curve is much slower than the flow of combustible mixture through that part of the tube adjacent the outer wall of the curve. In such a construction, the lowest rate of flow, that is the rate of flow adjacent the inner wall of the curve, determines and limits the maximum size of the induction tube. In my present invention, however, the outlet end **64** of the induction tube is made straight and this straight portion tends to eliminate the different rates of flow of different portions of the combustion mixture in the induction tube and tends to discharge all of the fuel and air mixture into the combustion chamber at a substantially uniform rate of flow.

I have found that where this straight end of the induction tube is given a length of ten times the diameter of this tube, all parts of the mixture discharged from the end of this tube are flowing at the same rate. It is ordinarily not feasible, however, to make the straight end of this induction tube of such length, but by wrapping part of the induction tube about the outer wall of the combustion chamber and having the straight discharge end of this tube extend through the wall of the combustion chamber and substantially across this chamber, this straight end can be made of sufficient length to substantially equalize the rates of flow of the combustible mixture in different portions of the cross-section of the induction tube. Such equalization materially raises the minimum rate of flow in a given size of induction tube and permits the utilization of a larger diameter induction tube which offers less resistance to flow therethrough and thereby reduces the over all resistance of the heater.

The straight end **64** of the induction tube is located in the combustion chamber and is exposed to the burning gases therein. This end, therefore, serves further to preheat the fuel and air mixture supplied to the combustion chamber. As best shown in Fig. 2, the outlet end of this induction tube is adjacent the end wall of the combustion chamber so that the burning gases must traverse the entire length of the combustion chamber before entering the heat exchanger. This construction permits all combustion to take place in the combustion chamber and prevents such damage to the heat exchanger as would occur if combustion took place in the gas passages **42** therein.

While I have illustrated and described only a single embodiment of my invention, it is to be understood that my invention is not limited to the particular details shown and described, but may assume numerous other forms and that the scope of my invention is defined in the following claims.

I claim:

1. A heater of the class described, comprising a cylindrical wall and an end wall forming a combustion chamber of cylindrical form, an induction tube for supplying a combustible mixture of fuel and air to the chamber, said tube being

of relatively large bore and having a straight end portion of appreciable length which extends through the cylindrical wall of the combustion chamber and substantially across the chamber at one side of the axis thereof, said chamber having a ring spaced from its end wall and extending inwardly from its cylindrical wall, means between said wall and said ring for igniting a combustible mixture, said end portion of the induction tube being disposed between said end wall and the plane of said ring, whereby the mixture delivered from the end of said tube is initially confined to a circular path in which it whirls about the axis of the combustion chamber in a ring of flame, said end portion of the induction tube being thus exposed to the burning gases and being heated thereby, serving as a preheating means for the mixture of fuel and air delivered through said tube.

2. A heater of the class described, comprising a cylindrical wall and an end wall forming a combustion chamber of cylindrical form, an induction tube for supplying a combustible mixture of fuel and air to the chamber, said tube being of relatively large bore and having a straight end portion of appreciable length which extends through the cylindrical wall of the combustion chamber and substantially across the chamber at one side of the axis thereof, a pocket adjacent the cylindrical wall of the combustion chamber, an igniter housed in said pocket, said wall having an inlet port positioned to admit a portion of the combustible mixture to the pocket for ignition

and having an outlet port leading from the pocket into the combustion chamber, said inlet port being disposed substantially opposite the open end of said induction tube to receive the combustible mixture directly therefrom.

3. A heater of the class described, comprising a cylindrical wall and an end wall forming a combustion chamber of cylindrical form, a heat exchanger having one end in open communication with said combustion chamber to receive hot products of combustion therefrom, means directing ventilating air over said heat exchanger and including a casing through which said air travels, an induction tube of relatively large bore connected into said casing intermediate the ends of the heat exchanger for diverting a portion of the air flowing through said casing, a carburetor arranged to feed liquid fuel into the air thus diverted into the induction tube, forming with said air the entire combustible mixture to be burned in the heater, said tube extending beyond said carburetor in a curved form wrapped around the cylindrical wall of the combustion chamber in heat exchange relation therewith for heating the combustible mixture in the induction tube, said tube terminating in a straight end portion of appreciable length which extends through said cylindrical wall of the combustion chamber and substantially across the chamber at one side of the axis thereof, and means for igniting said mixture as it enters the combustion chamber.

HENRY J. DE N. McCOLLUM.